Differences in feeding rates and reproductive success of House Wrens (*Troglodytes aedon*) between a disturbed and natural site

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Abstract

Urbanization is a major issue confronting species around the world and causing them to adapt, move, or die because of loss of habitat or food source. House Wrens (*Troglodytes aedon*) are small, cavity nesting, migrating, insectivorous birds common across the Americas. We hypothesized that the presence of humans and a disturbed habitat would cause fewer and smaller young to be raised than at an undisturbed area. We placed 50 Wren boxes in a woods bordered by a tall grass prairie and 50 boxes in a golf course, representing two levels of human disturbance. We checked these boxes three times a week from mid-April through mid-August and recorded their contents. On the fourth and twelfth days after hatching, we would observe how many times the adults visited the box. The laying date was earlier at the woods than the golf course, but birds at the golf course had larger clutches than those at the woods after controlling for laying date. Feeding rates did not varying between the natural area and the golf course. Our data shows that House Wrens are able to exploit various habitats and are tolerant of human disturbance.

Introduction

The encroachment of humanity on natural habitat has destroyed many local populations of wildlife. With the human population boom comes a need for housing, more and larger roads, more farm land to make more food, and more land for recreational activities. This new land is not coming from previously used or refurbished land, but from natural habitats (Sleeter 2008). Humans have brought habitat destruction (Krausman et al. 2009), pollution (Graveland 1998), and invasive species (Wilcox and Beck 2007) to different habitats worldwide. When natural habitats disappear or are altered, so does the food supply, shelter, and breeding grounds for the local wildlife populations. Habitat destruction is one of the leading causes for the decline of wildlife populations (Veech 2006).

Birds make good subjects for studying reproductive success because they are conspicuous during the breeding season. Bird communities have been found to be as diverse around golf courses as a natural area, but with less abundance of individuals within a species (Terman 1997) and less diverse when there was residential area near the golf course (Porter et al. 2005). This negative relationship between avian abundance and community diversity with increasing human disturbance shows that humans are narrowing the range of birds that will nest in an area simply by living there. Studies have reported how urbanization has affected bird communities but relatively few have examined how even small human disturbance can affect a single species.

When we focus on a single species, we can see how urbanization affects nesting areas, bird density, survival rate, and reproduction. Research done on one species seems to usually point to a lower reproductive success rate of individuals near development compared to individual birds away from development. The Northern Cardinal (*Cardinalis cardinalis*), a granivore, was positively affected by human disturbance. The increased January temperatures and undergrowth increased their winter survival, which led to high nest density but also high predation (Leston and Rodewald 2006, Rodewald et al. 2010). Because each species of bird has its own foraging specialization and habitat preferences, the effects of urbanization must be examined for each species of bird. For example, Acadian Flycatchers (*Empidonax virescens*), insectivores, exhibit detrimental effects from urbanization. Flycatcher body size, success rate, and reproductive capability were all affected negatively by the urbanization around Columbus, Ohio (Rodewald and Shustack 2008). This research on individual species demonstrates that species' response to urbanization varies, so the effects of urbanization must be evaluated for each species.

House Wrens (*Troglodytes aedon*) are an ideal species to study the effects of urbanization because urbanization has the potential to affect both their nesting sites and food supply. They are a common bird in northwest Ohio and are found in a variety of habitats. House Wrens use cavities and crevices to build their nests (Johnson 1998). Typically, dead trees are one of the first things removed by humans because they could fall on a building and cause property damage, or because they are not aesthetically pleasing. House Wrens attempt to find other cavities, such as in our buildings where they are not tolerated. The wren's preference for cavities makes them a good nest box species. They will nest in one nest box for the whole breeding season, and by adjusting box location, size, and style we can single out the wren for nesting study. Urbanization may also decrease the amount and quality of food. Humans use pesticides to kill insects around homes, golf courses, and cropland. Since the House Wren is an insectivore (Johnson 1998), it may not obtain enough food or must go farther and take longer to get the food in areas with human activity. A limited food supply could lead to small clutch sizes, smaller offspring, and higher chick mortality rates (Nooker et al. 2005).

We studied the relationship between urbanization and House Wren reproduction by observing the timing of breeding and feeding rates of wrens in 100 bird houses placed at a golf course and a wooded area. Our hypothesis is that House Wrens in a disturbed area will have fewer and smaller offspring than House Wrens in an undisturbed area. Compared to the forest site, the nest boxes on the golf course might have had higher human disturbance, higher density of egg and chick predators, increased use of pesticides, and less forest and shrub habitat (Neill and Harper 1990). In addition, we expect nestling feeding rates to be higher in an undisturbed area, because of the lack of pesticide use will allow birds to find more food closer to the nest. In particular, the pesticides may inhibit the wren's ability to properly feed not only itself, but its young (Luttenton 1989). Additionally, there are more shrubs in the young forest, providing more foraging opportunities than the manicured fairways and greens found on the golf course. We believe that the male will begin to help feed more in the late stages of nestling growth in order to maintain nestling health (Cox and Martin 2009).This study builds upon Newhouse et al. (2008), which compared feeding rates of House Wrens between a suburban area and a rural area. Our research was done on a golf course and a young forest, two habitats not considered in the previous study.

Methods

Study Species

The House Wren (*Troglodytes aedon*) is a very common bird that is widespread over the western hemisphere. The northern species migrates between northern North America and Mexico/Southern US (Rappole and Blacklock 1985). Their mating system is either social monogamy or polygamy with biparental care (Bart and Tornes 1989). The male will pick an area and build one or several nests which will entice a female to stay. Nest quality and quantity seems to be the only determining factor of choosing a mate (Johnson and Searcy 1993). House Wrens use cavities just about anywhere to nest with no or little preference to size, direction, or object in which the cavity is located (Johnson 1998). House Wrens are insectivores, and most insects can be found on the ground or in the subcanopy; so, this is where much of the wren's time is spent (Mirsky 1976). The House Wren is also able to produce two clutches in one season (Johnson 1998).

Field Techniques

We erected the nest boxes in mid-April. The nest boxes were erected in two general locations. The first site was the edge of the forest that surrounds the Ohio State Lima Campus in Lima, OH. The second site was a golf course within 5 km of campus. The nest boxes on the golf course were located off the fairways and in the surrounding shrubs and trees. In both these sites, the nest boxes were placed along the forest edge or in hedge rows. The nest box dimensions were 10.1 cm wide by 14.0 cm long by 20.3 cm high. The opening was a circle with a diameter of 2.9 cm and located 2.5 cm below the top of the box. This small diameter hole kept many other avian species from occupying the nest box. In order to trap the wren in the nest box for leg banding and measurements, a sliding trap door was fitted to the front of the box (Drilling and Thompson 1984). The boxes were placed 30 m apart to ensure maximum usage by the males (Muller et al. 1997).

We observed the nest boxes three times a week until mid-August when the House Wren mating season ended. We were able to closely expect the lay date based on the presence of a nest cup in the nest boxes. Once a nest cup was observed, the nest was checked daily until there were two consecutive days with the same number of eggs. The box was then left alone until our expected hatch date as to minimize researcher disturbance. The hatching date could be expected from the average incubation time of 12-13 days after the clutch was completed (Johnson 1998). On the expected hatch day, the nest was again checked daily until all eggs hatched or there were no additional hatched eggs detected (one or more eggs may not hatch). Hatch day was defined as the day when greater than 50% of the eggs had hatched. The boxes were then checked three times a week until the nestlings were 12 days old. When the nestlings were 12 days old, they were banded with an aluminum leg band and the following measurements were taken: mass (g), tarsus length (mm), wing length (mm), and tail length (mm). The nests were then left alone for 7 days to prevent premature fledging or parental abandonment. The nest was rechecked after 7 days to make sure the nestlings had fledged. This same process was repeated during a second brood if it occurred.

The adults were banded when the nestlings were 6 days old by trapping the adults in the nest box (Drilling and Thompson 1984). We measured the mass, wing length (from wrist to longest primary feather), and tarsus length (length of leg) of the adults, and banded them with federal USGS aluminum leg bands. The females had their right leg banded and the males had the left leg banded. This was done to allow us to identify if the male or female was the one returning to the nest to feed the nestlings. The banding also allowed us to determine if adults switch boxes in the middle of the season.

Feeding Observations

The parents were monitored on days 4 and 12 after hatching to observe how often feeding occurs in the two sites. On day 12, we were able to distinguish between the male and female during the feeding observations. The number of trips each parent made to the box was recorded from about 15 meters away using binoculars (8x42 Eagle Optics Rangers) and a spotting scope (20-40x80 Zeiss) for thirty minutes each observation (Newhouse et al. 2008). The birds were most active in the morning, so the observations occurred between sunrise and 6 hours after sunrise. We made note of the date, weather, nestling stage day, and time of day.

Statistical Analyses

We used a *t*-test or ANOVA, with a P-Level of 0.05, to compare egg laying date, hatch date, fledgling date, and nestling and adult mass, tarsus and wing length between the two field sites. The nestling measurements were an average of all the nestlings in an individual nest to avoid pseudoreplication. Possible effects of observer, temperature, wind and sky conditions were also considered. Wind was coded as no wind (0), 0-8 km/hr. (1), 8 km/hr. (2), 8-16 km/hr. (3), or greater than 16 km/hr. (4). Sky condition was coded as clear (0), cloud/sun (1), cloudy (3), or rainy (4). We used the program JMP (Ver. 8.0, ©2008 SAS Institute Inc. Cary, NC) to analyze our data.

Results

Of the 100 boxes monitored, 66% of our nest boxes had at least 1 egg in them (woods 31 of 50, golf course 35 of 50; likelihood ratio χ^2 = 0.05, N = 100, P = 0.83). The lay date tended to be earlier in the season at the woods (10 ± 24 June, N=35) than the golf course (17 ± 21 June, N=43; t = 1.87, P = 0.06), and was earlier for larger females (N=78, t = -2.58, P = 0.01; overall model: $F_{2,74}$ = 4.47, P = 0.01; Figure 1). The clutch sizes were larger during earlier lay dates (t = -9.72, P = <0.0001) and larger at the golf course (6.07 ± 0.88 eggs, N=43) than the woods (5.97 ± 1.15 eggs, N=35, t = 2.10, P = 0.04; overall model: $F_{2,75}$ = 47.46, P <0.0001; Figure 2). The incubation length for the wrens was the same at both locations (11.6 ± 1.0 days, N=78, F=1.50, P = 0.22) and shortened as the breeding season progressed (F=5.68, P = 0.02; overall, $F_{2,78}$ = 3.99, P = 0.02). Neither location or parent size affected nestling mass (9.32 ± 2.36 grams, N=78, $F_{4,44}$ = 1.12, P=0.36), tarsus length (16.45 ± 3.92 cm, N=78, $F_{4,44}$=1.13, P=0.35), wing length (30.7 ± 7.53 cm, N=78, $F_{4,44}$=0.91, P=0.47), and tail length (10.14 ± 3.13 cm, N=78, $F_{4,44}$=1.60, P=0.19). The adult female weight was similar between the woods and golf course (10.8 ± 0.5 grams, N=78, t=-1.64, P=0.11, F=2.69). Number of visits of the adults to the nest box when nestlings were 4 days old was similar between the golf course and the woods (9.0 ± 3.7 visits, N=80, t = 1.79, P = 0.08), and did not vary with time of day (t = 1.79, P = 0.06) and date (t = -0.46, P = 0.65; overall $F_{3,71}$ = 1.76, P = 0.16). Similarly, the number of visits of the adults to the nest box when nestlings were 12 days old was similar between the golf course and the woods (10.2 ± 4.4 visits, N=76, t = 1.79, P = 0.08), and did not vary with time of day (t = -1.32, P = 0.19) and date (t = -1.16, P = 0.25; overall $F_{3,70}$ = 0.94, P = 0.42). The number of fledged offspring increased with clutch size (4.9 ± 2.2 offspring, N=78, t = 3.30, P = 0.002), but did not differ with habitat (t = 1.37, P = 0.18) or laying date (t = -1.12, P = 0.27; overall model: $F_{3,74}$ = 13.95, P <0.001)

Discussion

We predicted that wrens at the golf course would feed their offspring at a slower rate and would produce fewer and smaller offspring than wrens in the woods. However, we found that reproductive success and behavior were similar between habitats, with the exception of laying date and clutch size. Wrens in the two habitats had similar number of fledglings, size of fledglings, and survival of fledglings, but surprisingly, wrens at the golf course laid larger clutches than those in the woods, even after controlling for laying date. The presence of humans and spraying the golf course greens and fairways with insecticides seemed to have had no effect on the birds. The larger clutches earlier in the year could be attributed to the time available to birds to lay and raise a large clutch. Likewise the second clutches were smaller because they did not have enough energy or time to raise a large clutch. Some research suggests that lay date and clutch size are related to the abundance of food (Tortusa et al. 2003).

Our second significant result was the lay date being earlier at the woods and for larger females. The trend that wrens in the woods laid earlier than those at the golf course is opposite to the clutch size results which favored those wrens at the golf course. The woods must be a favored habitat even if the golf course is sufficient to nest in, so woods become inhabited earlier. The larger females may lay earlier as a result of the energy they have available to them. Larger females may have more energy available to put into laying eggs and raising young (Nooker et al. 2005). A naturally larger female would not have to increase their energy stores by foraging more first, and could instead focus on reproduction sooner.

Our clutch sizes and laying dates were similar to previous studies, but we found variation in laying date between habitats. The wrens laid earlier in the rural habitats than the disturbed one. Acadian Flycatchers have been found to also lay earlier in the season in rural habitats than disturbed ones (Shustack and Rodewald 2010). Other research seems to have not looked specifically at this. Our laying date estimate was 14 ± 22.53 June days, which varies from the average laying data reported by Newhouse (2008) of 24 ± 1.2 April. The difference in laying date estimates may be to the inclusion of re-nesting attempts in our estimate. Our estimate of clutch size (6.03±1.00 eggs) was similar to 6.0±0.8 eggs reported by Robinson and Rotenberry (1991) in northwestern Ohio. Other locations average 6.4-6.5 eggs per clutch (Johnson 1998).

Contrary to our predictions, we did not find habitat differences in the feeding rates when nestlings were either 4 days or 12 days old. This observation is contrary to that found by Newhouse et al. (2008) around Washington D.C. and the Maryland area. They saw a drop in feeding rates both early and late stage in the urban birds compared to the rural birds (Newhouse et al. 2008). The reason for this difference in results is unknown. Some of the possible causes could be the difference in disturbed sites.

Newhouse used a suburban area while our research was done on a golf course. This is a different level and type of disturbance. Our birds were able to continue the same feeding rates at both locations regardless of human presence or disturbance.

The size of the offspring and the adults was not affected by location. This is again a little surprising because of the insecticide use at the golf course and previous studies have found differences in egg and nestling size. For example, American Robins (*Turdus migratoris*) have been found to have less massive eggs and young when the habitat was degraded compared to a less degraded habitat in the same area (Warkentin et al. 2004). In our study, similar nestling mass at both locations shows that the quantity of food the adults were supplying was comparable to the food at the woods. The nestling mass then could be a sign of habitat health, and the fact that the nestling masses were the same between habitats suggest that despite the insecticides, the golf course is as healthy as the woods.

When checking nesting boxes, the parents were far less skittish around us at the golf course. We were able to get much closer to the box before the wren started giving a warning 'chatter' at the golf course. The birds at the woods would often chatter at us even when we were 100 or more meters away from the box. This would seem to be evidence that the wrens were able to adapt behaviorally to human presence. Similarly, Pink-Footed Geese (*Anser brachyrhynchus*) have moved closer and closer to wind turbines to forage over the span of ten years demonstrating that some birds can adapt behaviorally to human presence (Madson and Boertmann 2008). This result along with our own observations point to birds being able to adapt behaviorally to human presence.

The main problems we experienced during the experiment were with the feeding rate observations. Often something like a bush would be in our way or the current weather would not allow for homogeneous observation conditions. However, we tested for the effects of weather and we found that weather did not impact the number of feeding visits that we observed.

Future research on House Wrens should focus on an even more disturbed habitat such as a housing community or even an urban setting. In addition, a multiple year study would be able to see if wrens prefer the same nesting locations repeatedly and to get an estimate of survival in the various habitats. The final conclusion of our research is that House Wrens are tolerant of human disturbance and can reproduce successfully as long as a nesting location is supplied.

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Fig.1: The date House Wren females laid their eggs compared to the mass of the females in two habitats near Lima, OH in 2010. Red squares and lines indicate the golf course; Blue diamonds and lines indicate the woods.

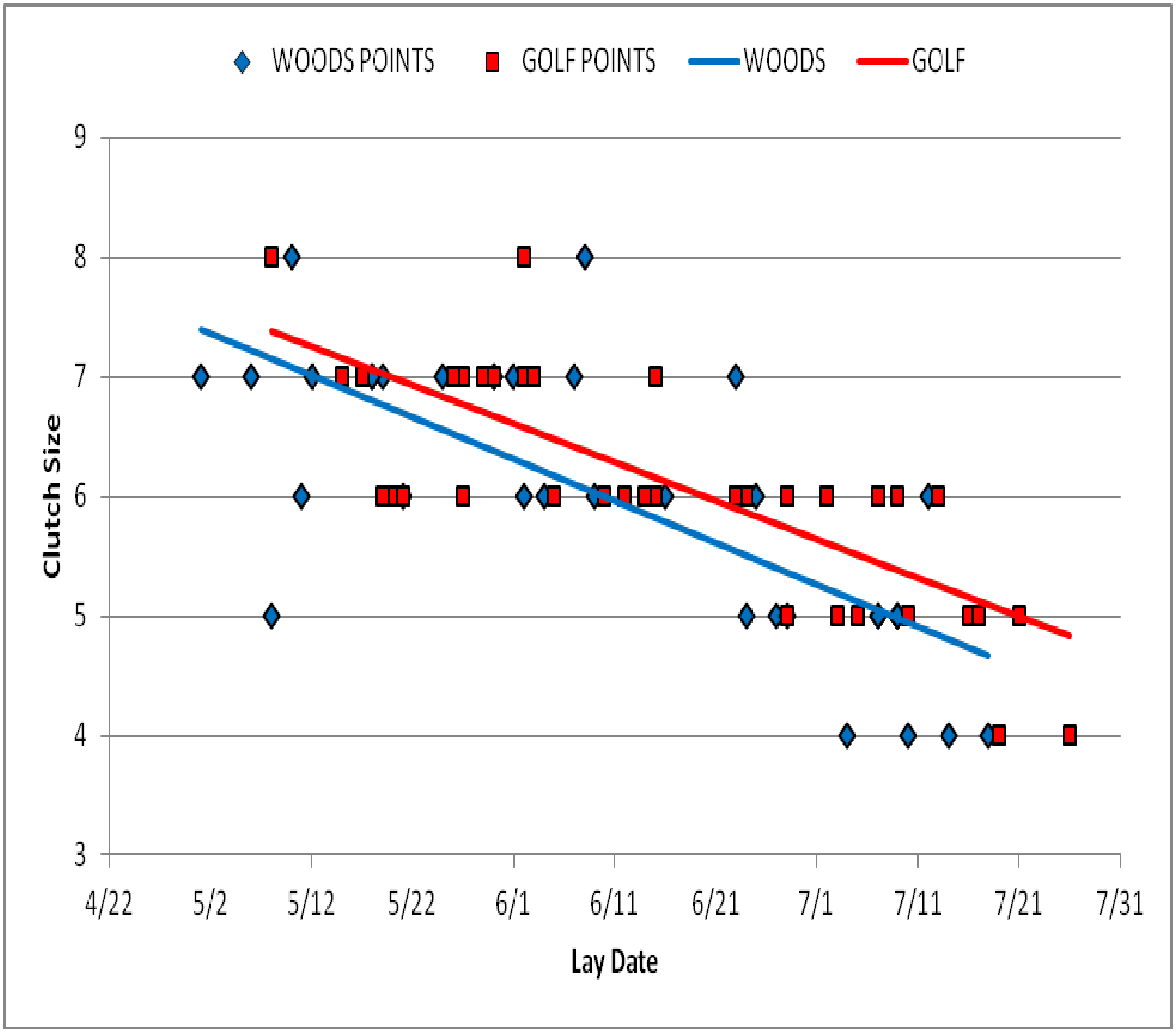

Fig.2: The number of eggs laid by House Wrens by the day of the year in two habitats near Lima, OH. Red squares and lines indicate the golf course; Blue diamonds and lines indicate the woods.